Chapter I

Introduction

1.1 Background

Technology is the source of energy. It enhances working speed, accelerates working efficiency, reduces overtime in work, minimizes numbers of human labors use, and provides economy to work. Man practice technologies to simplify their daily work to make them easier (Shrestha and Parajuli, 2010).Technological development is very much essential for the overall development of Nepal as it is one of the least developed countries in the world. 83% of total area consists of mountains and hills. Hence inaccessibility is the greatest hindrances in the delivery of essential services and development as a whole. The highly challenging topography and problematic hydro geological condition has rendered the extension of road network really capital intensive, daunting and environmental hazardous. (Practical Action, 2010).

The total road construction in the country in 2006/7 was 17782km which was 17433 in 2005/6 and 17279 km in 2004/5. (CBS,2008) .From the government data, just 62km road network was expanded in one year 2008/9.(Kantipur daily ,July 13 2009).This dismal picture shows the priority of Nepal government in road building.

In this whole scenario, Gravity goods ropeway is power to the rural economy. It is environment friendly and financially viable technology and has the potential to economically empower the marginalized people in rural area. It has supported better market linkage, increased income generation activities, improve access to health and education services and fostered better community relation. This mechanism works in single pulley system. It consists of two trolleys running over two separate towers at the top and bottom end. When the loaded trolley rolls down by its own weight along one track from upper station another trolley with light weight at the bottom station hauls up. For the safety and efficiency, the span of the gravity ropeway is recommended to limit of 1500m and it required at least 15 degree slope to operate smoothly (The Himalayan Times, May 19 2010). So before installation, the land topography must match these conditions .This is the topographical potentiality.

This gravity ropeway doesn't need any external power to operate .It runs by the natural gravitational force of the earth. So it is pro-sustainable development of any rural area to link between agriculture production potential rural pockets to the nearby market or transportation system. So it is helpful to improve rural livelihood by reducing transportation labors, transportation time and maintains the quality of the agric products. The Engineering works and other when making decisions about which technologies are appropriate for developing countries like Nepal should study weather the technology meets the actual needs of people, be affordable by the users ,be sustainable in the long term.(Nepal, 2010).Appropriateness of any technology also highlights its socio cultural acceptance by the local people.

Marketing linkage is the most important in the economic linkages in any area. The marketing system is the reflection of economic system in a particular region. The marketing linkage involves the flow of goods from production to final consumption through different marketing channels. Usually urban places in the rural region acts as the centers of exchange of goods produced in both rural and large cities. The urban centre may provide places for rural farmers or artisans to sell their directly to the final consumers. In such a case, no intermediary would be involved in marketing channels, which provides advantage to both a producer and consumers in term of price. (Pradhan, 2004).Thus Gravity good ropeway is an appropriate renewable energy technology that needs to be installed in every rural village with no road connectivity and correct topography to improve the rural livelihood.

1.2 Statement of the Problem

Inaccessibility is the greatest hindrances in the delivery of essential services and development as a whole. In the context of Nepal's rural areas, clean and reliable green energy technologies like gravity good ropeways seem to be less expensive and require less time to develop. But still the knowledge based on technical and other socio economic aspects of gravity good ropeway is not that broad. With this limited knowledge base, it is difficult chart out exclusive strategies for its development. Hence more is needed to be done in the areas of research and development. Involvement of academia like engineering institution would be important role in preparing of technical need of the rural community. They can play important role in the preparation of technical guidelines and code of practices. Likely, social research is required to find the niche of gravity goods ropeway in overall transportation sector, explore its potential as the complementary means of transport, identify existing policy hurdle if any propose more conducive policies and strategies.

1.3 Objective of the study

The general objective of this study is to access the potentially of installation and the need of gravity good ropeway for improving the rural livelihood.

The specific objectives are:

- To assess the topographical potentiality for installation of gravity good ropeway
- To assess the income benefit of farmer after installment of gravity good ropeway
- To analyze the socio-cultural issues regarding the installing gravity good ropeway

1.4 Scope of the study

The harsh topography of Nepal hinders the mobility of people and goods disconnecting plains with the hills. Head and backloads puts enormous physical burden on health of men and women. As such, construction of roads and air transport infrastructure poses huge economic and environmental costs for the country. To challenge the situation, green technology like gravity ropeway is making revolution for a change in transport sector development in Nepal.(Hada,2009).Installation of the gravity ropeway began in Nepal from 1975. To the date 18 gravity ropeway has been installed in various part of Achham, Kalikot, Gorkha, Tanahun, Dadhing, Surkhet and Mustang district of Nepal (Practical action, 2010). But we have 3915 villages' majority with rugged topography and no road connectivity. And the villagers have to walk hours of distance by carrying their agric products to the nearby market or transportation system to sell. So it is urgent to construct gravity ropeway in these places to make livelihood easier. Finding of this study will be useful for recommending planning and policy maker to formulate appropriate plans for further constructions of gravity ropeway in rural villages.

1.5 Limitation of the study

The study has mainly focus on primary than secondary data. It has been limited on Bukhel VDC ward no 7, 8 and 9 of Lalitpur district. It will collect data from the government related agencies, INGOs, its policy makers and individual basis of the study site. The study is applicable mainly to hilly and mountainous region without road connectivity and particularly to the link between agriculture production potential rural pockets to the nearby market or transportation system. More over there may be some socio-cultural issues regarding the gravity goods ropeway due to local social stratification and culture. So the findings of the study may not be applicable to other society and geographic locations.

1.6 Organization of the study

Chapter 1 begins with the general introduction of transportation scenario of Nepal rural energy technologies including Gravity Goods Ropeways, followed by the statement of the problem, objectives of the study, scope and limitation of the study. Chapter 2 deals with the review of the literatures. Chapter 3 deals with the methodology and the approaches applied in the research, and the criteria considered for selecting the study site.. In chapter 4, study area is described through the use of map, tables, figures includes location and accessibility, education status, population, occupation. In chapter 5, observations and findings of the study is presented along with analysis to fulfill the research objectives. In chapter 6, major findings are drawn from the data presentation and analyses are presented, with the recommendations for the policy measures at the end.

CHAPTER II

Literature Review

2.1 LAND TOPOGRAPHY OF NEPAL

Nepal is a mountainous country. 83% of total area consists of mountains and hills. Hence inaccessibility is the greatest hindrances in the delivery of essential services and development as a whole. The highly challenging topography and problematic hydro geological condition has rendered the extension of road network really capital intensive, daunting and environmental hazardous. As of now, according to the road statistics, Nepal has a total road network of 18828 km only which brings the road density of about 12.79 km per 100 km^2 lowest in south Asia. This however varies significantly in urban and rural area. About six million people will need to walk at least four hours to get to nearest road head.

Ever since the planned development has begun in the country, transportation sector has topped the country's development priority which is manifested by the proportion of the budget it arrested in each development plans. Still, the hard fact is that some district headquarters are yet to be connected by road network. In this pretext it seems impossible that the road network will reach to each and every settlement of the country in a conceivable future. Similarly, due to sparse nature of settlements and low density, in many instances the huge investments on the road construction failed to justify. For such low density areas and the settlement at the hill top having no prospect to be connected by road network in near future, gravity goods ropeways presents itself an innovative and appropriate solution. It bridges the gap between the head loading \back loading and conventional means of transportation i.e. road by connecting the hill tops with it. It taps inexorable gravity and facilities the movement of goods in the hills. It doesn't transport human being but relived the, from the travel needs tremendously as the marketing of the goods constitutes the major part of the transportation need of rural dwellers. It inherently and essentially complement the rural road as it takes on where the road leaves off and contributes in the financial viability of rural roads by feed it from adjoining villages.

Nepal government's 20 years Agriculture Perspective Plan (1995 A.D. to 2015 A.D.) has identified inadequate transport infrastructures and facilities as the major obstacles in the growth and commercialization of the agriculture sector. Despite the fact that around 70% of the budget allocated by government in rural infrastructure development has been earmarked for rural road construction every year, the agriculture roads are far less then sufficient to boost the agriculture development. Each year good amount of local harvest goes to waste due to no or poor access to market outlets. On this backdrop, the farmer managed gravity goods ropeway, can prove to be catalytic input to attain high agricultural growth. It reduces the travel time from village to market to 2 min thus facilitating the transport of the vegetables and fruits to the market afresh. It brings down the transportation loss of perishable vegetables to nil. Success stories tells that besides

trimming down the transportation drudgery of farmers, it reduces the transportation cost by 70% saved transportation time by 90% and payback 20 to 30 % of the project cost in one year of operation (Singh,2010).

2.2 Rural technologies in Nepal

There are huge potentialities of producing energy in Nepal. Availability of enormous water resources and topographic situation give rise to a potential for 83,000 mw of hydropower of which about 43,000 mw of power production seems to be economically and technically feasible. Till now, where only about 563 mw has been harnessed which is mainly consumed in urban areas, the rural and remote areas of the nation have no access to reliable energy. In the other hand, in spite of enough possibility of producing energy in rural areas in the form of biogas, solar energy, wind energy, improved water mill, micro and mini hydropower, it has not been used as per the needs. In this context, there is ample possibility of improving the living standards of rural population by developing by developing environment friendly energy resources in rural areas by making financially affordable to reduce dependency on traditional and fossil fuel resources (Rural Energy Policy, 2006).

In the context of Nepal's rural areas, clean and reliable green energy technologies like gravity goods ropeway seem to be less expensive and require less time to develop. But still the knowledge based on technical and other socio economic aspects of gravity good ropeway is not that broad. With this limited knowledge base, it is difficult chart out exclusive strategies for its development. Hence more is needed to be done in the areas of research and development. Involvement of academia like engineering institution would be important role in preparing of technical need of the rural community. They can play important role in the preparation of technical guidelines and code of practices. Likely, social research is required to find the niche of gravity goods ropeway in overall transportation sector, explore its potential as the complementary means of transport, identify existing policy hurdle if any propose more conducive policies and strategies(Singh,2010).

2.3 Gravity goods ropeway

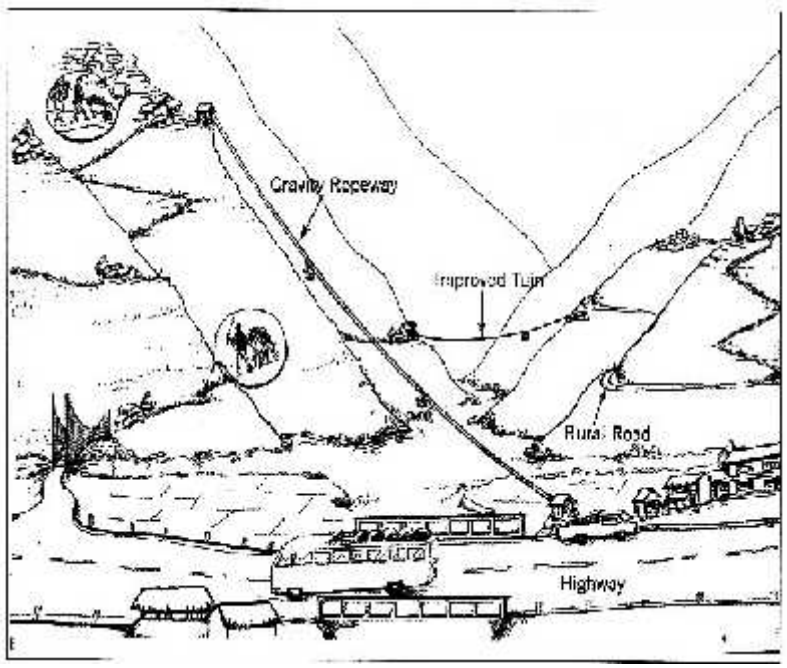
Rope transportation is one the oldest forms of transportation. Gravity ropeways or gravity shots have been in use in forestry and mining industry from ancient times in various part of the world. It is very popular for apple transportation from uphill orchard to the road head in Himanchal of neighboring country India.

If we trace back the history of gravity ropeway development in Nepal, it is found that there mono-cable gravity ropeways were installed in Sikkha valley of Myagdi district in 1975 with the help of JICA. After years of stagnation, in the year 2001, Practical Action in Nepal, a UK based INGO, in

association with International Center for Integrated Mountain Development (ICIMOD) successfully demonstrated bi-cable gravity ropeway technology in Marpha, Mustang district to transport apples directly from the orchards to the road-heads. Ever since, the organization is promoting this technology as a complementary means of transport systems in rural Nepal by modifying and advancing it for increasing safety and technical feasibility.

2.3.1 Working Principle

Fig 2.3.1: Gravity goods ropeway during operation



The mechanics of gravity ropeway is very simple. It consists of two trolleys, rolling over two separate steel wire ropes (track ropes) supported and suspended over two separate tower at the top and bottom ends. The trolleys are connected to a single looped wire rope (hauling rope) of a smaller diameter by means of rope ties. This hauling rope passes around the cast iron sheave fixed end. When the loaded trolley rolls down by its own weight along one track from the upper station, another trolley with lighter weight hauls up along the next track rope. A simple brake with a rubber/wooden brake shoe is fitted to the sheave at the lower station to regulate the speed of the moving trolleys.

As a rule of thumb, the weight ratio of downward to upward moving load should be maintained at 3:1. However, the ratio varies with the slope of the profile and precision maintained during installation of gravity ropeway. Hence, proper loading ratio per site should be carefully evaluated after the ropeway comes into operation and stick to it (Singh, 2010).

2.3.2 Feasibility

Sustainability of a gravity ropeway by and large depends on the discretion of the site selection. Proposed site should be evaluated against some technical, economic and social parameters which are discussed as follows:

a) Technical feasibility for the installation of Gravity goods ropeway

- Slope of the hill should be with in 15 to 40 degree. But experience has shown that ideal slope for a gravity ropeway installation is 20 to 30 degree.
- The span should be within 1500 m for a single span.
- There should be flat and stable land for the landing platforms at the stations. The flat land followed by the abrupt drop is preferred at the upper station.
- The profile of the hill should be such that it provides enough clearance for the required sag. The cross ridges should be avoided as far as possible in between the stations.
- The upper station should be close to village and bottom station should be proximate to the road or market.
- There should not be any settlements, roads, electric transmission lines, main trail and other facilities just below the ropeway alignment.
- The ropeway alignment should be such selected that it causes no or minimum harm to the existing environment.

b) Socio-economic feasibility for the installation of Gravity goods ropeway.

- The villages to be connected by the gravity ropeway should be the pocket areas of some produces where commercial farming has already started. If not, there should be enough production in the village to send to the market(the volume of the local produces going to the market should be at least there times more than the volume of consumers goods coming to the village)
- The traffic volume (the produces/goods going to and fro the market) should be sufficient enough to ensure the regular (year round) operation of the gravity ropeway and sustain in long run.
- Presence of well mature community based organization is imperative for its installation, operation and maintenance.

Even the technical feasibility of gravity ropeway has bearing with socio-economic feasibility hence it should precede the technical feasibility (Singh, 2010).

2.4 Features of Gravity goods ropeway

Gravity good ropeway possesses some intrinsic features which make it suitable in the hills and mountains of Nepal. Some of them are discussed below.

a. Simple, low construction/installation cost and minimal operation and maintenance cost:

Gravity ropeways employs very simple technology hence can be installed, operated and maintained by mobilizing local resources. It is cheaper in comparison to the conventional means of transport like road, railways etc. Approximate cost of a gravity ropeway installation is Nrs 1,200,000 to 1, 50,000 depending upon the location of the site whereas the construction of 4m wide earthen road in the hills cost approximately Rs. 30, 00,000 per kilometer.
As the gravity ropeway doesn't require any fuel or highly skilled human resources to operate and maintain, it's running and maintenance cost is minimal.

b. Time saving and short:
Goods can be transported through gravity ropeway within minutes. Unlike to the roads ad railways where the winding of alignment is unavoidable to acquire the gradient, gravity ropeways are laid straight "as the crow flies". Hence, its route is very short.

c. Energy efficient:
Gravity ropeway is green technology. It doesn't use fossil fuel hence it is emission free. It doesn't disturb ambient environment and the existing ecology. It has no or negligible impact on the surrounding environment as it doesn't require heavy cuts and fills as in the case of building motor able roads (Singh, 2010).

d. Environment friendly:
Gravity ropeway is environment friendly technology. It neither causes noise nor air pollution. It does not disturb ambient environment and the existing ecology. It has no or negligible impact on the surrounding environment as it does not require heavy cuts and fills as in case of building motorable roads . The alignment is worked out very carefully in order to avoid the clearance of trees and vegetation. Being a low cost technology, as per existing regulation, the Initial Environment Examination (IEE)/ Environment Impact Assessment (EIA) for the gravity ropeway installation is not required.

e) Simple technology:
Gravity ropeway employs very simple and robust technology which can be operated and maintained by local communities. It does not require external experts apart from the inputs and technical facilitation in surveying and designing, which can also be done by local engineers and technicians.

f) Nominal operation and maintenance cost:

As the gravity ropeway does not require any fuel or highly skilled manpower for its operation and maintenance, its running and maintenance cost are minimal (DoLIDAR and Practical Action Nepal office, 2010).

2.5 Beneficiaries

The primary beneficiary of the gravity ropeways are the farmers residing in the isolates hill tops who produces or have potential to produce. It brings market closer to them thus facilitating the export of local produces and import of agro input consumer's goods. It breaks the vicious circle of low production/ productivity and difficult marketing and ensue a virtuous circle of high production and commercialization. The market is often exploiting for poor farmers when they deal with it individually. Gravity ropeway brings them together thus enhancing their bargaining power. It gets them bulk up and exits their produces from one outlet, thus attracting the larger traders eventually reliving them of the exploiting local traders. Similarly, gravity ropeways are owned by the community themselves hence the tariff collected goes to the community fund. As its operation and maintenance cost is comparatively low, the fund collected can in a long run sustain a cooperative bank giving them community financial independency (Singh, 2010).

2.6 Marketing linkage

Marketing linkage is the most important in the economic linkages in any area. The marketing system is the reflection of economic system in a particular region. The marketing linkage involves the flow of goods from production to final consumption through different marketing channels. Usually urban places in the rural region acts as the centers of exchange of goods produced in both rural and large cities. The urban centre may provide places for rural farmers or artisans to sell their directly to the final consumers. In such a case, no intermediary would be involved in marketing channels, which provides advantage to both a producer and consumers in term of price (Pradhan, 2004).

So in order to promote backward and forward linkage, gravity good ropeway is the power to rural economy. It is environment friendly and financially viable and has the potential to economically empower the marginalized people in rural area. It has supported better market linkage, increased income generation activities, improve access to health and education services and fostered better community relation.

2.7 Geographic Positioning System.

GPS is a device from which the coordinate and altitude of any area can be determined. It is geo reference device from which the coordinates and altitude of any area can be determined. It is a geo reference device. It has tremendous scope for use in GIS data collection, surveying and mapping. GPS is used for identifying precise positioning of geo-spatial data collection in the field (Sharma, 2007).

2.8 Geographic Information System

GIS is an organized collection of computer hardware, software, graphic data and personnel designed to efficiently capture, store update, manipulate, analyze, and display of graphically referenced information (Mandal, 2010).

The latest trend of technological development refers GIS as an important tool for evaluating development programs, monitoring environmental changes and need assessment like selecting areas for particular development i.e. school , health post, bridge, telecommunications, road network, drinking water projects ,gravity good ropeway etc.

2.9 Case studies

Review of the relevant literature review includes a case study of Fishling Gravity Ropeway, Gorkha where it takes a steep ascend of two and half hours from the bank of Trishuli river to the Devistan of Bhumlichowk VDC, Gorkha. The inhabitant of the Magar community is a pocket area of tomato production. However, till 2009 only few farmers had taken up the vegetable farming as the main source of income. It would take whole day to transport the vegetable to Fishling bazaar, well aware of the plight, would take advantage of it. Farmers were forced to settle on whatever meager price traders set for their produces s carrying back the vegetable to the village really arduous. In many instance, the price their produces fetch would fail to justify the labor they put in for its production and the transportation drudgery. Hence, the smallholder farmers were discouraged for vegetable farming and they rather opt to cereal crop for their household consumption. The big farmers were not making much money either, as the major part of their income would drain on transportation.

With installation of Gravity goods ropeway in 2009, things have changed drastically for better. Now the vegetable reach to Fishling bazaar with in two minutes a fresh. Now, all the farmers have to do is to produce and transfer it to the upper station of Gravity goods ropeway which is at 5 minutes walk from the center of the village. The Gravity goods ropeway and their co operatives take care of rest. They don't have to descend to Fishling bazaar either, as the cooperative do the marketing for them and they collect their money at village it self. Now people have started to do the vegetable farming literally in every inch of their land. Since, the Gravity goods ropeway has

take up the transportation burden; the vegetable farming has increased three fold. According to the operator of the ropeway, in last Ashar, the transaction of the vegetable through was more than Nrs. 1 lakh per day. The following table shows, the vegetable and cash flow at ropeway in eight months in operations.

A. Investment

Description	Amount
Users contributions	190,200
Projects contributions	1,169,648
Total investments	1,359,848

Length - 1412m
Slope angle - 26°
Construction completed- 2065 Chaitra

B. Income

1. Details of goods transported and cash income of GR in 8 months

Month	Top to bottom		Bottom to up		Total		Expenses
	Kg	Amount	Kg	Amount	Kg	Income Rs	
Total	165,506	124,130	18,620	13,965	184,126	138,095	71,200

2. Transportation saving in terms of cash

Total produces transported village to market(kg)	165,506
Cost saving @ Rs 2.25 per/ kg(before installation of GR user have to pay Rs. 3/ kg to the porters)	372,389

3. Time Saving in terms of cash: (For a single year)

(The transported goods reach to the station with in less than 2 minutes)

For Down ward transport:

Total produces transported village to market	165,506	
Number of load(assuming 50 kg per load)	3,310	
Time saving @1.5 hours per load	4,965	Hours
Total person working 8 hrs per day	620	Person days
Converted to cost @ Nrs 250 per day	155,162	

Total income (1+2+3) = Nrs. 594,446 which is 43.7% of total investment

(Singh, 2010).

Review of another relevant literature includes a case study from Janagaun village, Benighat VDC, Dadhing which states that the cost of the project was shared among the different stakeholders for the successful installation of the project. Donor provided the materials which born cost and technical support where as the local users provided free unskilled labors and materials that found at local level freely. In this regards, the volume of work from local users become quite high and was difficult to acquire, especially for wooden logs. Further, the availability of wooden logs of good quality for anchoring the cable not always possible as expected or recommended by the designer. In such case, it has-been recommended to use reinforced concrete or steel structure in stead of wooden logs in other similar project. Having a socio technically feasible site is another major challenge. For this it would be wise to prepare some kind of master plan for Intermediate Means of Transportation at the district level.

Isolation is one of the main contributing factors to poverty. Limitation to do with travel and movement can isolate people from the outside world. This will inhibit their access to markets and services. They will be totally dependent on subsistence activities rather than growing cash crops or doing other economic activities.

Mostly women (of Nepal) spend large portion of their productive time on within village travel to fulfill daily household needs. Improving of transport infrastructure, services will connect them with the outside markets and opportunities, health and services will contribute to achieve sustainable and equitable livelihoods for the poor men & women.

Accessibility in the mountains of Nepal has been one of the main development challenges of the country. The rugged mountains pose an obstacle to the mobility of the people and transport of goods and services, and have become a source of constraint to development efforts. While construction of roads is generally very capital-intensive, massive construction and time consuming though under the high priority of the country, air transport is proven to be uneconomical in transporting agricultural produce to the potential market.

In the region like Nepal covering geologically young hills and mountains, which necessarily demands a huge investment and exists some risks in developing infrastructures for accessibility like road network to cater services to sparsely located settlements. In most of the hill and mountain areas, both the communication and transport of goods are carried through pedestrian trails by human and animal (mule and goats) carriers.

Improving accessibility in the hills and mountains of Nepal has been one of the main developments Challenges of the country. It has been really necessary to develop, adopt or replicate affordable, accessible and appropriate modes of transport in the rural hills of Nepal to contribute towards improvement of livelihoods of rural poor people.

Of different modes of technologies in transporting goods, the Gravity Goods Ropeways that has been recently introduced in Nepal (only three are under operation) have been found to be very

effective. They are one of the most appropriate, affordable, efficient, simple and locally managed transport system for poor communities living in isolated areas of highland However these environment-friendly technologies (such as ropeways kind of non-motorized means of transport) are not adequately reflected in the government policies.

Principally the goods coming downwards from top station has to be thrice (not exceeding maximum load of120kg) as heavy as the load going up from the downhill. The speed of the trolley depends up on the angle of elevation made by the cable installed with the horizontal ground and the load on the carrier box. Normally here in this project carrier box with a load of 100kg take 1.5 minute to reach to bottom. A flywheel with bearing and bracket is used as a brake to control the landing speed of the trolley at the bottom station.

Communication between stations is done by tapping on the support cables at both ends. The operator at the top station strikes the wire rope with a stick to send a wave signal to the operator at the down station. The operator at the down station then sends back similar signal way up to operate the system; he/she then applies the hand brake to control the flywheel at bottom station to stop the trolley

The Gravity Ropeways do not disturb ecological systems as other motorized options, nor does it pollute the environment during construction and operation of the scheme. It will reduce the environmental cost which otherwise government and society have to bear in construction and operation of traditional roads and bridges. As this is a non-motorized transport system which leads to reduction in the use of fossil fuels and thereby reduces the green house gas emission. With comparing to other transport project like road, bridge, it has negligible harm to the natural environment due to its less occupancy (almost require 55square meter for each station) in ground. Similarly the mountain slopes are not de established. It has comparatively lesser occupancy factor in ground. It does not pollute air. It does not have the tendency to trigger landslides. It does not need any external source of power except the gravity for its operation.

Challenges and Barriers:

The major challenges are identified in adapting the technology in village.

• Identification of technically and socio-economically feasible sites has been a challenge as it has limitations in terms of maximum span, inclination and sag and also potential productions in the up hills.

• As technology being not matured enough, there are still issues on part of standardization of designs and safety in terms of operation and maintenance of the ropeway.

• Non availability of specific configuration of wire-ropes that are required for the use of ropeway, the wire-ropes commonly available in country supplied by national traders are with the configuration of –6X7 strand with steel core for track cable and with jute core for haulage cable.

Thus it requires longer period of time for manufacturing in India to manufacture the rope of specific configuration required which affects the delivery of the project in time
(K.C, 2010).

A case study of the Janagaun Village after field survey

Table 2.11: Description of ropeway at Janagaun village

Description	Remarks
length	1.4 km
Use	Goods transportation
Load capacity	120 kg
Beneficiaries (HHs)	179(direct)
Beneficiaries(population)	496(direct)
Local consumer group	Jana-gaun Gravity ropeway Consumer group
Contributions of local	Unskilled labor, land stone, wooden log, mud(Rs. 416,314)
Technology used	Using earth's gravitational force, larger weight goods are transported from top to bottom and small weight goods are lifted up
Constructed date	2062-2-28 B.S
Economic help	European commission
Total cost	Nrs 863,175

(Field survey, 2011)

Above information indicates that the ropeway has brought a drastic change in the rural livelihood. But during field survey it has been found that, just after the 5 years of construction, the ropeway work has been partially halted. This is because the road network has just been connected up to the village, such that villagers use vehicles for transportation of their agriculture products. They only use ropeway during the rainy season. So the technology has failed here because it was constructed without proper homework like the possibility of motorable road construction in the area , calculating either vehicles transportation is cheap or ropeway and , social issues like elites(who owns vehicles) domination in the region. This Janagaun Gravity ropeway is good place of further research about assessing the necessary policies to be adopted for the ropeway construction in the new place.

Hence, review of literature shows that Gravity goods ropeway is not an alternative to road transportation but it rather add values to the existing road network by complementing it in roods transportation from the remote locations to the road. For fostering better market linkage

between rural hinterland and market center there is need of good transportation system. But in case of Nepal, due to rough topography and less priority of government on building roads , green technologies like gravity goods ropeway can be supportive to improve rural agro economy as it is pro-sustainable development of any rural area to link between agriculture production potential rural pockets to the nearby market or transportation system. So it is helpful to improve rural livelihood and addresses some gender issues by reducing transportation labors, transportation time and maintains the quality of the agric products. But there is need of more research and development in the sector of gravity goods ropeway like social, cultural and economic impact of the transferred technology in the rural villages.

CHAPTER III

RESEARCH METHODOLGY

3.1 Selection of study area

The study area Bukhel V.D.C is selected as it lies in the remote region of Lalitpur district, about 35 km far from the Chapagaon bazaar. The Bukhel bazaar which is the nearest market of the region is connected with a graveled motorable road (at around 1300m asl). Where as the study site Gholechappra and its surrounding hinterland Dimindada, Lamidada, Solithum, Todke, Chyulidada lies at an altitude of 1500m to 2000m asl. The study site doesn't have motorable road connectivity.

Due to rugged topography, it may take several years for doing construction of road. But the study area is the potential pocket area for commercial vegetable farming and dairy production which is the main source of livelihood in the region. Villagers have to walk a long distance in a steep slope to reach the Bukhel bazaar carrying their agriculture loads on their body to sell them.

So the study area is selected to find out weather the area the Gravity goods ropeway can be developed as the complementary means of transport in the region.

3.2 Research design

The research is both descriptive and exploratory in nature. The study consisted of the desk study of available literature on gravity goods ropeway development in Nepal, discussions with professionals and field visits and discussion. It has mainly focused on the feasibility study. both in terms of technical and socio-economic for the installation .All the relevant data/ information ,hence were collected with the help of Topo maps, GPS, checklist, interviews and observation in the field and were analyzed systematically and scientifically with interpretations by GIS. This study has been more empirical with relevant primary data collection from the study area.

In the research, it is difficult to study whole universe under study due to high cost, time consuming and complexities. Therefore, sampling plays important role in research work. Data collected without a proper sampling procedure and suitable sample size may not meet the objectives

Table 3.3: Sample description

Settlements	Total HHS	Sample percentage	Sample number
Gholechappra	13	50	7
Chyulidada	15	50	8
Todke dada	10	50	5
Dimin dada	30	50	15
Lamidada	25	50	13
Solithum	27	50	14

Table 3.3 gives information about among the total number of directly study affected 120 HHs, 62 HHs were selected purposively by stratified sampling method and one member from each household were further interviewed.

3.4 Nature and sources of data

This study has been more empirical with the relevant primary data collected from the study area. For the better and in-depth analysis and subsequent interpretations secondary data have been amply too used. To generate primary data household survey (focusing study area), a pre-tested semi structured questionnaire was used for interviewing the selected respondents. Moreover, another semi-structured checklist was prepared for guiding the direct field observations. Collected information was triangulated through field and participant observation and key informants.

Analysis of available secondary data compiled from various sources such as reports/records of DDC Lalitpur and other different published and unpublished documents such as books, journals, articles of different GOs, I/NGOs and institutions through various websites.

3.5 Techniques of data collection

Different techniques such as reconnaissance, interviews, observations etc were administered as to extract the relevant information. These techniques have been described briefly in the following:

3.5.1 Reconnaissance Survey

Reconnaissance survey was done at the initial stage to get an overview of the study area. This survey was conducted to get basic information on the situation of the study and to get introduced to the people during initial visit, which was useful to built rapport with local people. The existing bio-physical condition, location of market, school, and VDC offices and general information about culture and socio-economic condition was considered.

3.5.2 Interviews

As a major technique, sampled respondents were interviewed individually. Even an in depth interview was carried out with a respondents to dig out the social problems after the installation of gravity good ropeway.

3.5.3 Observation

It was another technique used the course of study. I visited sampled households of all the study are of six settlements in order to know the agriculture potentiality, market linkage, topographical ruggedness and prevailing transportation system.

3.6 Tools for data collection.

3.6.1 Field checklist

A checklist was prepared for field observation .The semi structured checklist had two parts which could widely cross check data collected in the field and seek ample suggestions for making the study much more effective. Among the two parts the first part had issues related with technical aspects ie GPS coordinates, GPS errors, elevation for the possible upward and down ward stations of gravity good ropeway. The second part include about the identification of possible settlements going to be served, existing market linkage, existing service delivery infrastructures etc. Its format is included in Annex 1.

3.6.2 Topo maps

A 1:25000 scale Topo sheet (2785 10A) was taken for supporting baseline data (Department of Survey, 1995). It contains basic elements for planning and development of natural resources and human activities. Latitudes, longitudes or grid lines (co ordinates), contour (elevation), rivers, roads, settlements (town and villages), land uses etc are basic elements contained in this map sheet. These elements are essential for identification of any natural resources and human activities, and their location and associated features.

3.6.3 Land Capability Map

A land capability map sheet no: 72 E/7 is taken for secondary data collection (Department of Survey, 1984). For many agriculture land development program, covering areas, the necessary planning document must be prepared. The land capability classification is one of the basic documents for this purpose. It gives the direct information regarding the soil potentiality of different area. It is the scientific appraisal of the physical characteristics of the land, its inherent soil qualities, and the farm management practices (Singh J., 1994).

3.6.4 Land System Map

A land system map sheet no: 72 E/7 is taken for secondary data collection (Department of Survey, 1984) . A land system map gives information about the land form, dominant soil types and its various qualities like texture, drainage etc.

3.6.5 Land Utilization Map

A land utilization map sheet no: 72 E/7 (Department of Survey, 1984) is taken for secondary data collection. Land use is an important aspect of geographical studies in agriculture geography. Land use maps are used to know the extent to which land is being used and to understand the variation in its use and productivity.(Singh J.,1994).

3.6.6 GPS

A GPS device (e Trex H by Garmin) with accuracy less than 10meters was taken to calculate field coordinates.

3.6.7 Interview schedule

An interview schedule was taken for the simplicity of primary data collection.

3.6.8 Case study

Two case studies were carried out to know about the real scenario before and after the project launched. One case study is from Gorkha and other from Dadhing.

3.6.9 Field note

Field note was used as an important of my research process to record all the relevant information detected during the field information.

3.7 Data Analysis Procedure

All the completed questionnaires were checked and transformed into a preliminary data sheet. Then after, the data were edited and classified so as to meet the objectives.

3.8 Research process

The research began with bringing thoughts on the problem areas and preparing scientific research proposal. Series of discussion were supervisor encouraged critical thinking on concepts used in this research. Colleagues and other professionals provided inputs during informal discussions.

CHAPTER IV

Description of the study area

4.1 Location and accessibility

Fig 4.1: Map of Lalitpur district

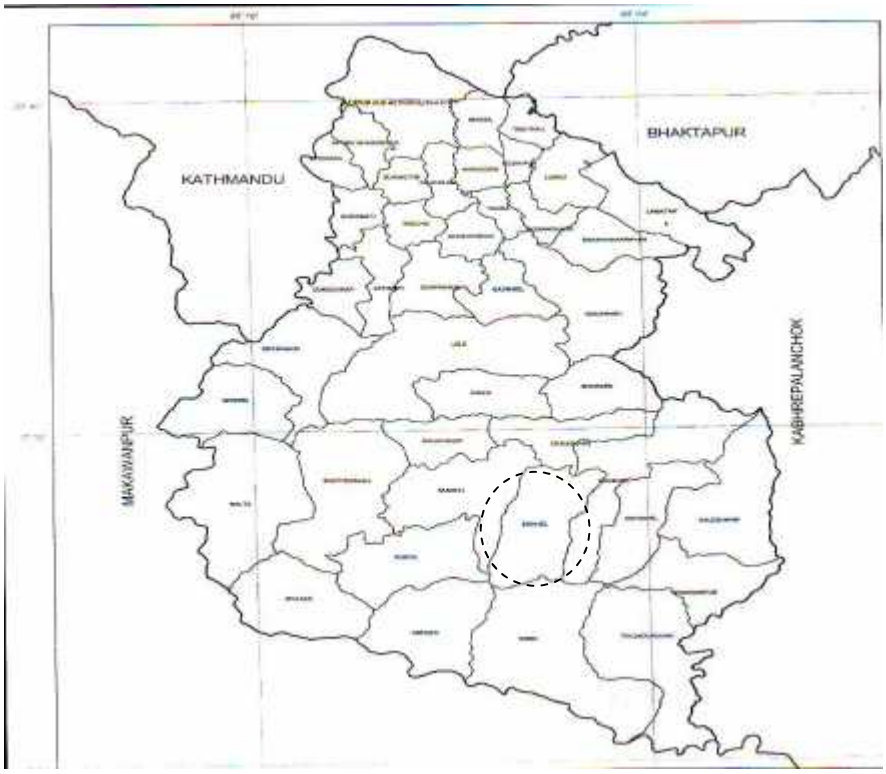


Fig 4.1 shows that the study area lies at Bukhel VDC in Lalitpur district. Lalitpur district is in Central Development region of Nepal. It has boundaries with Kathmandu, Bhaktapur, Kabhrepalancowk ,Makwanpur.

The study area comprises six settlement i.e. Gholechappra, Dimindada, Solithum, Todke dada, Lamidada, Chyulidada. The motorable road network is connected up to Bukhel bazaar via Gotikhel bazaar.

Fig 4.1: Bukhel VDC with its ward boundaries

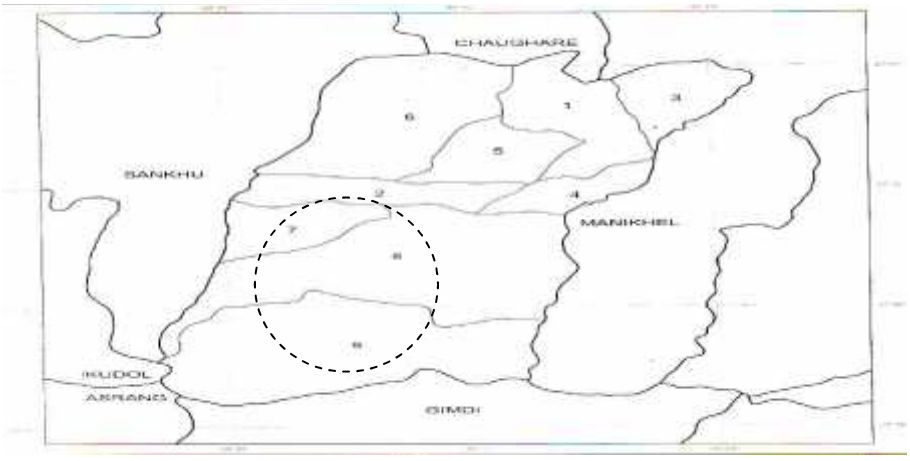


Fig 4.1 shows the study area.

The proposed upper station (Gholechappra) is in ward no. 8 and proposed Kalidevi School is in ward no. 7. Other study area comes under ward no. 9.The above settlements are accessible to reach only through trail roads through Bukhel bazaar.

4.2 Topography

The study area comprises six settlements that lies between UTM coordinate 633000E to 641000E and 3041000N to 3043400N.The altitude range varies from 1500m to 2000m asl.

Table 4.2: Altitude of different settlements

S.N	Settlement	Altitude (m asl)
1	Gholechappra	1530
2	Chyulidada	1600
3	Todke dada	2000
4	Dimin dada	1600
5	Lamidada	1800
6	Solithum	2000

Here, the table 4.2 shows in the study area Gholechappra is at lowest altitude at 1530 m asl whereas the Todke dada and Solithum are at the greatest altitude which is 2000m. Interestingly Bukhel bazaar is at very low altitude ie.1300 m asl.

Source: Field survey, 2011

The study area is a rural setting. So the settlement is scattered. This is due to the uneven distribution of earth's resources. Generally the isolated settlements over the hill region are a result of rugged topography where the distribution of resources such as arable land, water etc is scattered, but they are also the natural sites with pleasant exposure. In hills, scattered arable land is one of the principle factors of tiny and dispersed settlements (Pradhan, 2006).

This condition is also applicable here. Gholechappra (near to the Bukhel bazaar) is alike a Khukuri shaped structure with 13 HHs mainly Brahmins. Where as, at Lamidada, all the 25 HHs people are from mainly Tamang ethnicity.

4.3 Population

Since the study area comprise dispersed settlements there are 120 HHs with 897 populations.

Table 4.3: Population status of different settlements

Beneficiaries	Janajati	Other	Total HHs	Male	Female	Total population
Gholechappra	2	11	13	36	42	78
Chyulidada		15	15	70	50	120
Todke dada		10	10	30	40	70
Dimin dada	4	26	30	115	125	240
Lamidada	25	0	25	108	92	200
Solithum		27	27	87	102	189
Total	31	89	120	446	451	897

Source: Field survey, 2011

Table 4.3 illustrates about the population status of different settlements. Among total 897 population 50.27 percentages is of female whereas 49.73 percentages is of female. Among 120 HHs 25.83 percentages HHs is of disadvantaged groups mainly Tamang ethnicities.

4.4 Education status

The definition of literacy includes those people who can read and write.

Table 4.4: Educational attainment of the HH members by sex

Settlements	Male (n)	(%)	Female(n)	(%)	Total(n)	(%)
Gholechappra	25	70	21	50	46	60
Chyulidada	52	75	22	45	74	60
Todke dada	15	50	12	30	27	40
Dimin dada	92	80	75	60	167	70
Lamidada	43	40	9	10	52	25
Solithum	43	50	31	30	74	40
Total	270	60.8	170	37.5	440	49.16

Source: Field survey, 2011

Table 4.4 illustrates about percentage of the literate people who had attained educational institution by sex. The study area has 49% people literate. This rate is highly different with male and female. Among total population, 60.8 percentages of males are literate whereas only 37.5 percentages of females are literate.

4.5 Major occupation

Table 4.5: Major occupation of the respondents

Major occupation	Total HHs(120)	
	Respondents(n)	%
Vegetable selling	52	44
Milk production	40	33
Wood selling	4	3
Teaching	16	13
Others (Porters)	8	7

Table 4.5 shows that 77% people in the study area take agriculture as the main profession. Among 120 HHs, 4 HHs have their own private forest, so they sell wood. Similarly 13 percentage of the total HHs have teaching as profession and 7 percentage of the total HHs is porters. It shows that, the study area is very potential for the vegetable farming.

Source: Field survey, 2011

4.6 Market linkage

The nearest existing market for the study area is Bukhel bazaar and Gotikhel bazaar .Furthermore the people of the region visits big market like Chapagaon, Lagankhel and Kathmandu to buy various goods like Dhuto/pina, rice, chemical fertilizers, oil, salt, sugar etc. Daily 3 or 4 mini trucks carry vegetables, milk from the region to sell in the Lagankhel, Kalimati bazaar.

4.7 Travel time

People of the different six settlements have to walk on the steep trail road to reach the nearest market. So the walking distance is measured in terms of time. The major achievement of the study area will be then, if their walking distances carrying goods is reduced.

Table 4.7 : Time to reach the Bukhel bazaar from the concerned settlement and vice versa

Settlement	Time(min) for up down transport	Time (min) for down up transport
Gholechappra	30	50
Chyulidada	80	100
Todke dada	105	125
Dimin dada	60	80
Lamidada	90	110
Solithum	65	85

Source: Field survey, 2011

Table 4.7 shows the travel time for people of different settlements during up-down transport. The nearest settlement is Gholechappra. So it takes 30 minutes time to reach Bukhel bazaar from the settlement whereas it takes 50 min time to reach Gholechappra from Bukhel bazaar. Similarly the farthest settlement is Todke dada. So it takes 105 minutes time to reach Bukhel bazaar from the settlement whereas it takes 125 min time to reach Todke dada from Bukhel bazaar.

4.8 Local energy fulfillment

The study area is very rugged topographical, with altitude range from 1299m asl to 2000m asl. So still the various parts of the region haven't been electrified with central Grid. But the local efforts have succeeded to electrify their houses. There are three rivers in the region ie Tungun Khola, Khamandol Khola and Palejeu Khola. There are many Peltric sets connected. Gholechappra is also being benefited form 3kw, Peltric set cum water mill project. For cooking purpose, people use local forest resource (Field survey, 2011).

CHAPTER V

DATA PRESENTATION AND ANALYSIS

This section deals with the overall analysis of the field that the researcher had acquired through the field study. In the process of analysis, researcher highlights the potential development of Gravity goods ropeway and its impact n rural livelihood in the study area of Bukhel VDC. To justify the statement the statement the researcher had analyzed both qualitative and quantitative data. Gravity ropeway is an appropriate green energy technology used to link between agriculture production potential rural pockets, without road connectively to the nearby market or transportation system.

5.1 Assessing topographical potentiality:

From literature review, the technical feasibility needs the slope of the hill should be with in 15 to 40 degree. But experience has shown that ideal slope for a gravity ropeway installation is 20 to 30 degree. The span should be within 1500 m for a single span. There should be flat and stable land for the landing platforms at the stations. The flat land followed by the abrupt drop is preferred at the upper station.

The profile of the hill should be such that it provides enough clearance for the required sag. The cross ridges should be avoided as far as possible in between the stations. The upper station should be close to village and bottom station should be proximate to the road or market. There should not be any settlements, roads, electric transmission lines, main trail and other facilities just below the ropeway alignment.

The ropeway alignment should be such selected that it causes no or minimum harm to the existing environment.

- From our calculation, using GIS system we found the length of the proposed ropeway is 491m with slope angle 25.6°. It is shown in fig 5.1.1.
- There is flat and stable land for the landing platforms at both stations. Upper station (at Gholechappra) falls on the private land owned by Buddhi Krishna Ghimire .But during field research he is willing to provide the land for ropeway construction. The bottom station comes under the premises of Shree Kalidevi School. The school management committee is also willing to provide the necessary area for ropeway station but with some conditions like sharing economic benefit with school and operating the ropeway on during before or after school hours.
- The profile of the hill also provides 90% clearance for the required sag. Remaining 10% is disturbed by the grown up trees which can be cleared.

- The upper station is close to the village and bottom station is connected with the motor able road.
- There is no any settlement just below the ropeway alignment but there is electric transmission lines which can be reallocated.
- The ropeway alignment causes minimum harm to the existing environment so it can be considered.

5.1.1 About the technical feasibility

Table 5.1.1: Geographical status of the proposed upper and bottom station

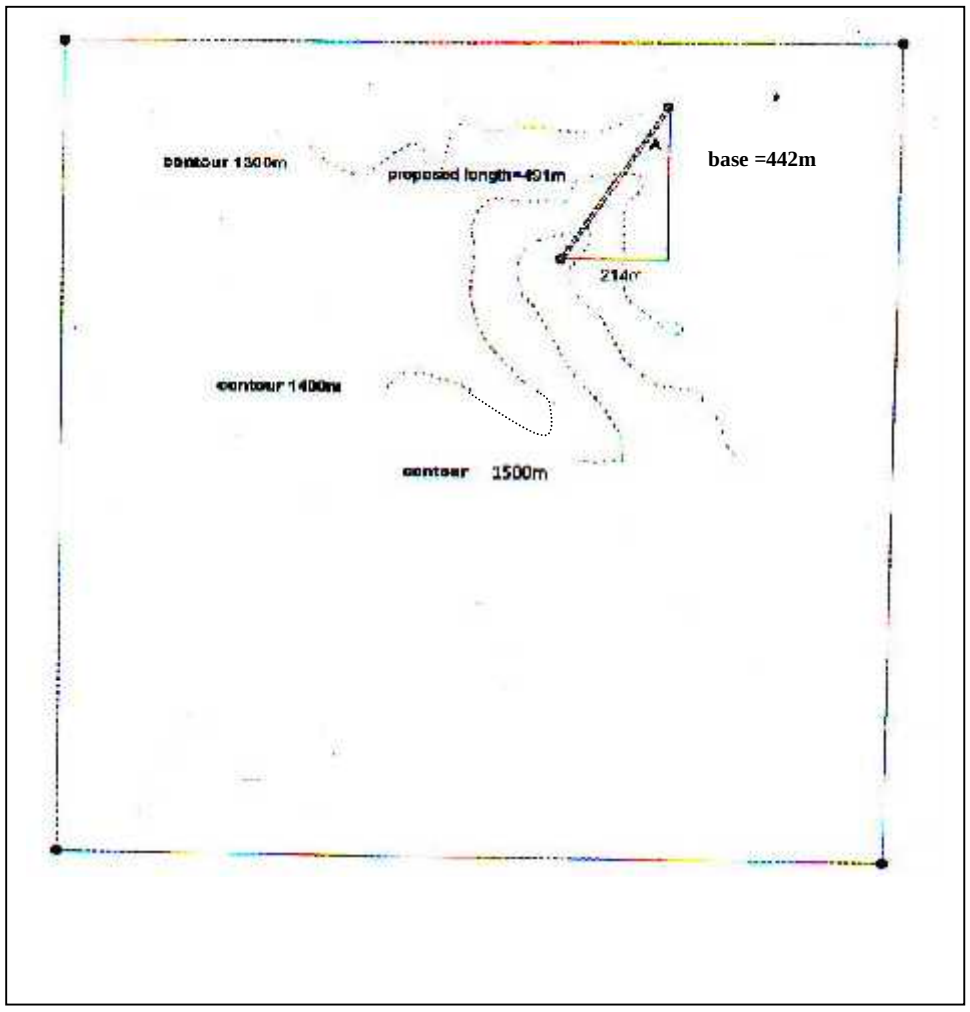
Settlement	GPS error	Elevation(m)	Upper station(GPS)	Bottom station(GPS)	Length	Slope angle
Gholechappra	5 m	1513m asl	634202 3042640		491m	25.6°
Kalidevi School	4m	1299m asl		634459 3043059		

Source: Field Survey, 2011

Table 5.1.1 shows that the proposed upper station is Gholechappra with elevation 1513 m and coordinates 634202E and 3041640N.Similarly the proposed bottom station is Kalidevi school at Bukhel bazaar with elevation 1299m and coordinates 634459E and 3043059N.The detail calculation is shown is Annex 5.

Fig 5.1.1: Technical feasibility of the study area

Fig 5.1.1 shows the various contour levels along with proposed upper and bottom stations. The ropeway alignment is also shown. The proposed ropeway is of length 491m. The calculation of the slope angle is in annex 4. It has been found that the slope angle of the ropeway alignment is 25.6 °. The length (491 m) and the slope angle (25.6°) of the proposed ropeway also matches the standard terms and conditions of Gravity goods ropeway construction. So the study area is technically feasible for the ropeway construction.



The proposed upper station is at an altitude of 1513m asl and proposed bottom station is at an altitude of 1299m asl. The tangent of the ropeway alignment is calculated in Annex 5. It shows that the slope angle is 25.6 ° .Both the station can provide 55 square meter area in the ground.

Thus it can be analyzed that the proposed area for gravity goods ropeway construction is topographically potential.

5.2 Geographical condition of the study area

From the field survey it has been found that Gholechappra settlement is surrounded by other 5 settlements as in the map. A trail road (in arrow direction) is connected to every settlement as in the fig 5.5. A motor able (not pitched) road is at low altitude i.e.1300 m asl at Bukhel bazaar.
The geographic status of the study site is very rugged.

Fig 5.2 : Altitude of different settlements

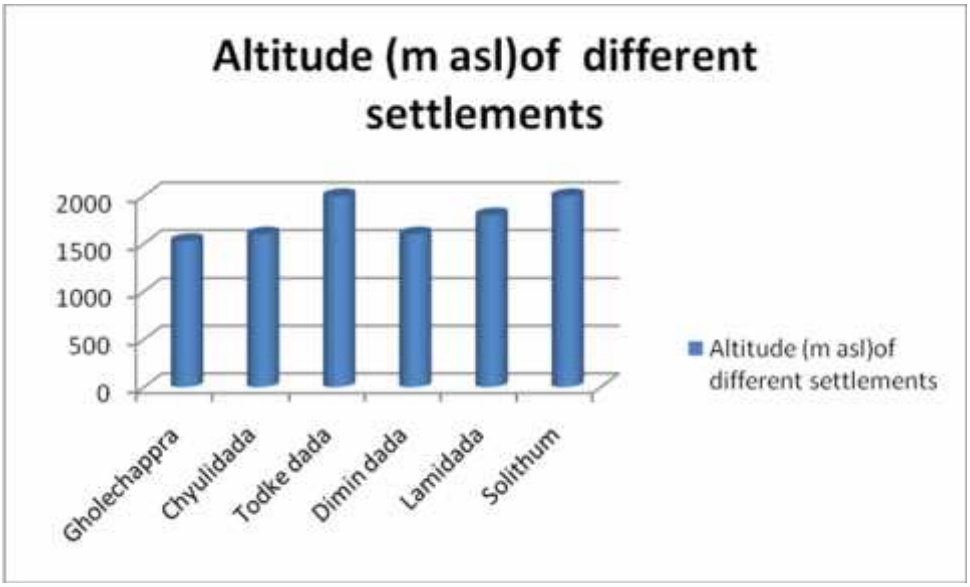


Fig 5.2.1 shows the altitude of different settlements. Here Gholechappra is at lowest altitude at 1530 m asl whereas the Todke dada and Solithum are at the greatest altitude which is 2000m.
Thus due to rugged topography, it may take several years and large economic fund for the construction of the motorable road. The villagers will have to suffer a lot by carrying heavy loads of vegetables, milk, other imported goods like Dhuto/pina, rice in the steep slope. So it is urgent to construct the ropeway in the region for maintaining the better livelihood of the farmers.

5.3 Major agriculture production in concerned settlement

The major agriculture production of the study area is pea and milk which is the main source of livelihood in the region. This indicates the commercialization of the agriculture in the region.

Table 5.3: Major agriculture production in different settlement

Settlement	Respondent HHs	pea	milk	coffee	wheat	maize	mustard	Other vegetables
Gholechappra	7	3	2	1	1			
Chyulidada	8	2	3		1	2		
Todke dada	5					3	2	
Dimin dada	15	3	7					5
Lamidada	13	6	4			3		
Solithum	14		8			6		
Total	62	14	24	1	2	14	2	5

Here Table 5.3 shows that mainly the study area is slowly moving towards cash crop production (pea, coffee, vegetables) due to access to the market.

Table 5.3.1: Average production per HH per day

Settlement	Average production (per day per HH)	Major agriculture productions
Gholechappra	22 kg	pea, milk, coffee
Chyulidada	21 kg	milk, wheat, maize
Todke dada	18 kg	maize, mustard
Dimin dada	23 kg	milk, vegetable
Lamidada	20 kg	milk, maize
Solithum	17 kg	milk, maize, wheat

Here Table 5.3.1 shows that mainly the study has average production 20 kg per HH per day. The production of Dimin dada is maximum, which 23 kg per day perHH is. Similarly the production of Solithum is minimum, which 17 kg per HH per day.

5.4 Major goods imported in concerned settlement

The major import of the study area is Dhuto/pina which is the main livestock feeding materials in the region. Since the study area comprises the high altitude above 1500m asl, there is no proper irrigation system and rugged topography, rice cultivation is impossible in the region. So majority of people also imports rice. This indicates the commercialization of the agriculture in the region.

Table 5.4: Major goods imported in different settlements

Settlement	Respondent HHs	Dhuto/pina	Rice	chemical fertilizers	Oil	salt
Gholechappra	7	4	2			1
Chyulidada	8	4	1	3		
Todke dada	5	3	1	1		
Dimin dada	15	7	5	1		2
Lamidada	13	4	3	3		3
Solithum	14	8	2	2	2	
Total	62	30	14	10	2	6

Table 5.4 shows that that mainly the study area import livestock feeding materials. This shows the potentially of the region to work as commercial livestock farming.

Table 5.4.1: Average import per month per HH

Settlement	Major imported goods	Average import per month per HH
Gholechappra	Dhuto,pina, rice	150 kg
Chyulidada	Dhuto, pina, salt, rice	145 kg
Todke dada	Dhuto,pina, fertilizers, rice	155 kg
Dimin dada	Dhuto, pina, rice	150 kg
Lamidada	Dhuto,pina, salt	145 kg
Solithum	Dhuto, pina, oil	145 kg

Table 5.4.1 shows that the average import is 150 kg in an average per HH in 1 month. The major goods imported area Dhuto, pina and rice. The maximum import of the Dhuto/pina, rice is from Todke dada which is 155kg per HH per month. This is due to the less availability of arable land, more grazing land and more livestock.

5.5 The route and time taken by goods to reach the market after the installation of gravity good ropeway.

Gholechappra is the common transit point of all settlements. If the ropeway is installed, people of different settlements will walk up to Gholechappra and they will export agriculture products to the market through ropeway. The trail road being used at present is shown in arrow head direction in fig 5.5.

The nearest settlement from the Gholechappra is Dimindada which is at 30 min walking distance far .Similarly Todke dada is the farthest settlement which is 75 min walking distance far. From Gholechappra it takes 30 min during up-down transport to reach Bukhel bazaar.

Fig 5.5: Map showing the time taken to reach bottom station after ropeway construction

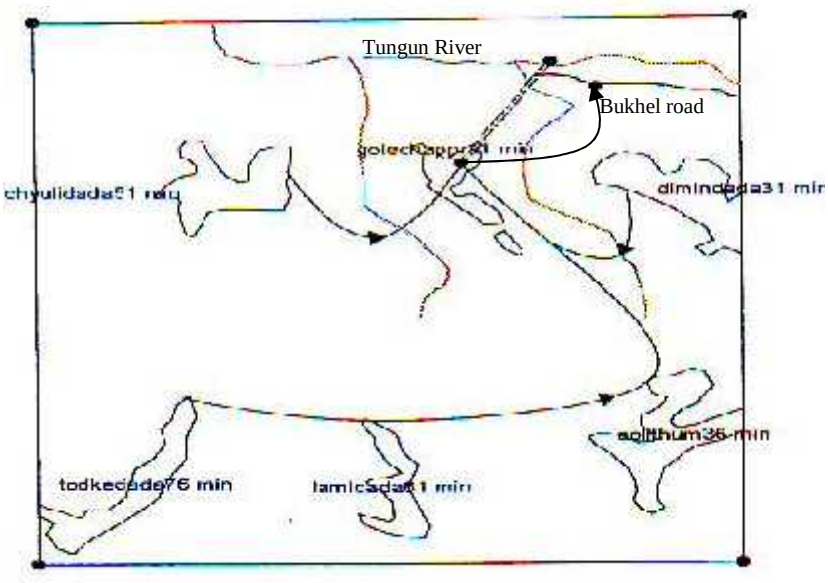


Fig 5.5 shows that the people of different six settlements are now using trail roads for goods transportation. If the proposed ropeway is installed at Gholechappra, the walking distance is reduced by 29 min during up-down transport. As shown in the fig the dotted line segment is the proposed ropeway.

Table 5.5: Time taken by goods to reach the bottom station after ropeway construction:

Settlement	Time (before ropeway construction) in min	Time(min) after ropeway construction	Time saved in min
Gholechappra	30	1	29
Chyulidada	80	51	29
Todke dada	105	76	29
Dimin dada	60	31	29
Lamidada	90	61	29
Solithum	65	36	29

Table 5.5 shows that though it takes more than 30 minutes time for each settlements to reach bottom station, the ropeway takes just 1 minute

time to transport goods. Thus 29 minutes time per person is saved. This saved time can further be utilized in other production activities.

Fig 5.5.1: time saving during up- down transport

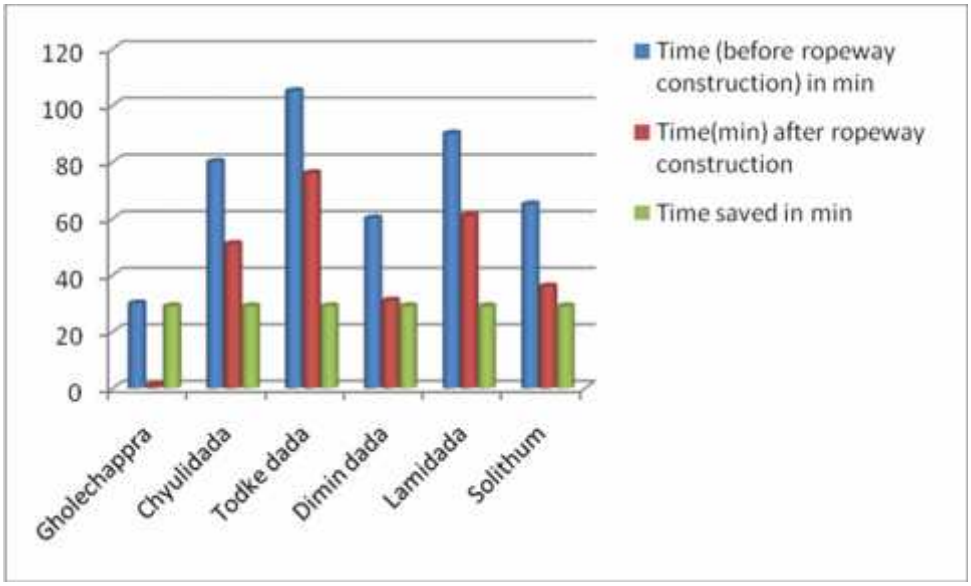


Fig 5.5.1 shows the time consumed and saved before and after the installation of ropeway during up-down transport. It shows that after the ropeway construction, 29 minutes per HH is saved. The total time saved has been converted in terms of cash. The detail calculation is in Annex 4.

5.6 The route and time taken by goods to reach the village after the installation of gravity good ropeway

Gholechappra is the common transit point of all settlements. At present people are using trail road (in arrow head direction in fig 5.6) for goods transportation. If the ropeway is installed, people of different settlements will walk up to Gholechappra and they will collect goods imported from the market through ropeway.

Fig 5.6: Map showing the time taken to reach bottom station after ropeway construction

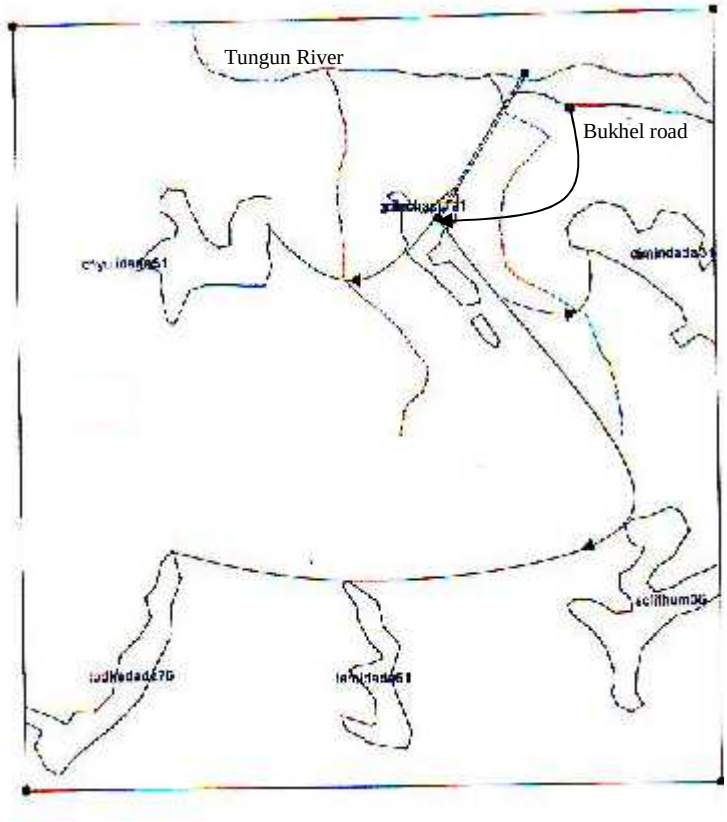


Fig 5.6 shows that the people of different six settlements are now using trail roads for goods transportation. If the proposed ropeway is installed at Gholechappra, the walking distance is reduced by 49 min during down – up transportation of goods. Gholechappra is the transit point. From bottom station to Gholechappra, it takes 50 min walking distance time for goods transportation without ropeway. If the ropeway is installed , the goods will reach to Gholechappra in 1 min.

Table5.6: the time taken to return village after ropeway construction

Settlement	Time(min) after ropeway construction	Time(before) in min	Time saved in min
Gholechappra	1	50	49
Chyulidada	51	100	49
Todke dada	76	125	49
Dimin dada	31	80	49
Lamidada	61	110	49
Solithum	36	85	49

Table 5.6 shows that though it takes more than 50 minutes time for each settlement to reach concerned settlements from the market, the ropeway takes just 1 minute time to

transport goods. Thus 49 minutes time per person is saved. This saved time can further be utilized in other production activities.

Fig 5.6.1: time saving during down-up transport

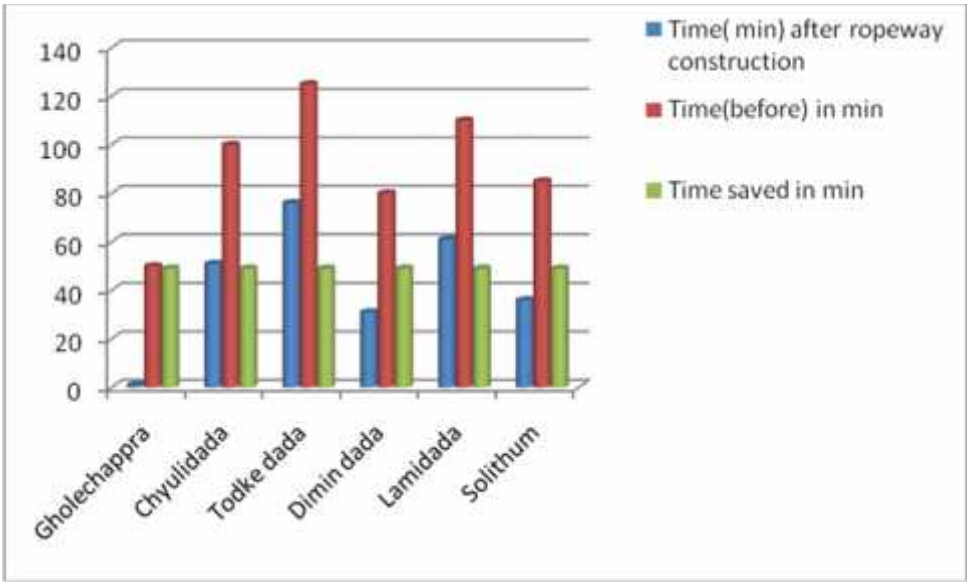


Fig 5.6.1 shows the time consumed and saved before and after the installation of ropeway during down-up transport. It shows that after the ropeway construction, 49 minutes per HH is saved. The total time saved has been converted in terms of cash. The detail is in Annex 4.

Fig 5.7 shows the aerial view of study area . Here the trail road being used and the alignment of the proposed ropeway is shown . The ropeway just takes 1 min to transport goods where as people has to walk more than 30 min for up-down transport and more than 50 min for down-up transport for goods transportaion.

5.8 Analysis of Land capability map

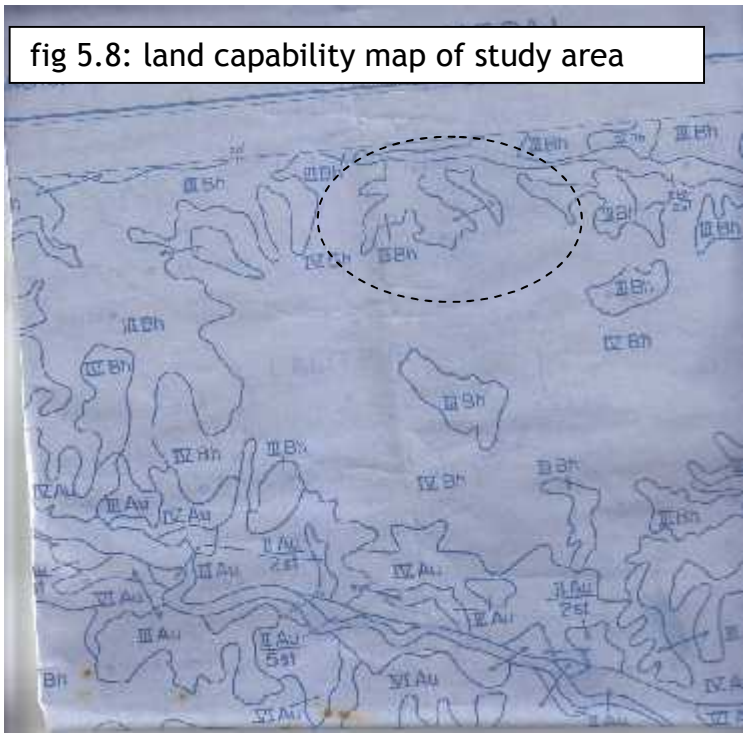


fig 5.8: land capability map of study area

Map 5.8 is the land capability map for Solithum (our study site) region has indicator |||Bh. The Class ||| gives information that Lands are moderately to strongly sloping (5-30°) and soils are 50- 100 cm depth and well drained. There are few limitations of traditional forest use provided adequate ground cover is maintained. Terracing is mandatory to control erosion when used for arable agriculture. Under the existing agricultural system a large portion of class ||| is required for fodder production and grazing in order to maintain the productivity of the cultivated lands. The subclass B gives information that the study area has warm temperature (1000-2000m),(15-20 °c) Subdivisions(moisture regimes) h indicates that study area is humid. It gives information that the study site is capable for agriculture production.

5.9 Analysis of Land system map

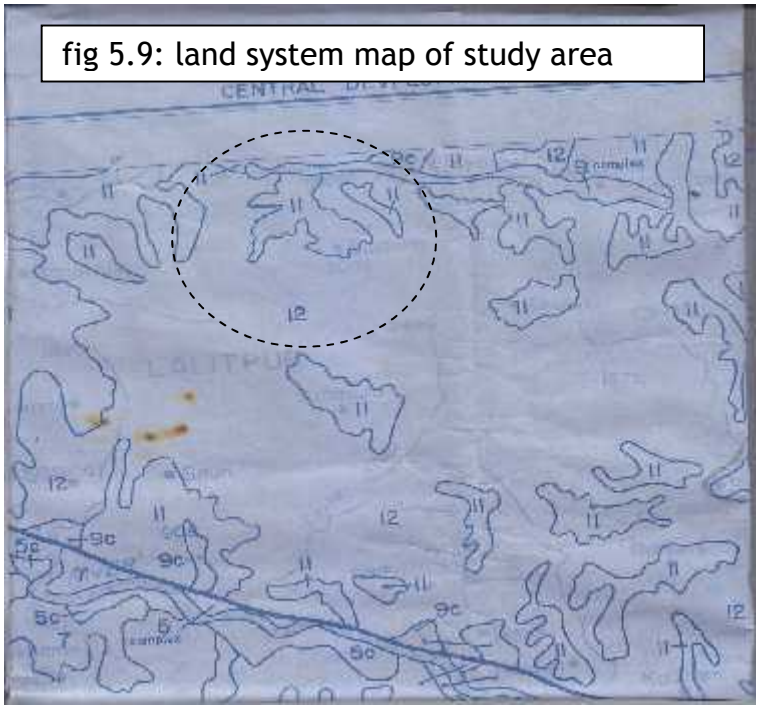


fig 5.9: land system map of study area

Map 5.9 is the land system map for Solithum region (our study site) has indicator 11.

The legend gives information that Study site is in Middle mountain region. The Land form is moderately to steeply sloping mountainous terrain. The Dominant soils are Typic, Rhodic, Udic, Anthropic, Subgroups of -Ustochrepts, Dystrochrepts, Haplumbrepts.The dominant slopes is less than 30 °.

The Seasonable range of depth to water table is more than 50 cm to bedrock. The drainage is moderately well to well. Thus, it gives information about various soil characteristics of the region which indicates that the study site is capable for agriculture production.

5.10 Analysis of Land utilization map

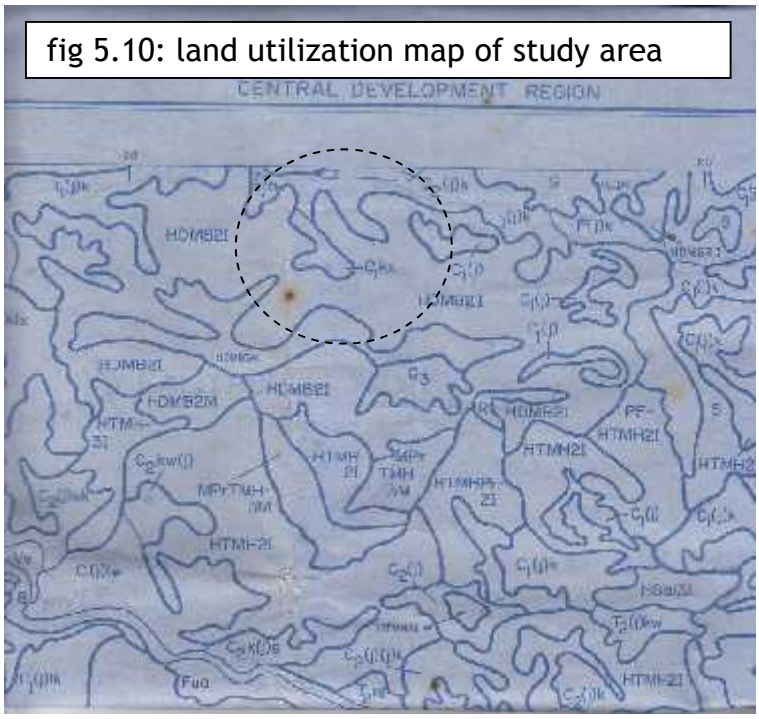


fig 5.10: land utilization map of study area

Map 5.10 is the land utilization map in which the Land use legend (C1KX) gives information that legend C is sloping terraces.1 represents that 25 to 50 % land is cultivated with dominant cropping pattern. K represents that there is maize production during monsoon season and mustard during winter dry season. . X represents that there is maize production during monsoon season and potato during winter dry season.

Thus it gives information that the study site is being used for agriculture production.

Table 5.10 : Comparison between seasonal productions

Seasonal production	(GoN, 1984)	(Field survey,2010)
Monsoon-winter dry	Maize-mustard	Maize- mustard
Monsoon-winter dry	Maize-potato	Maize- pea

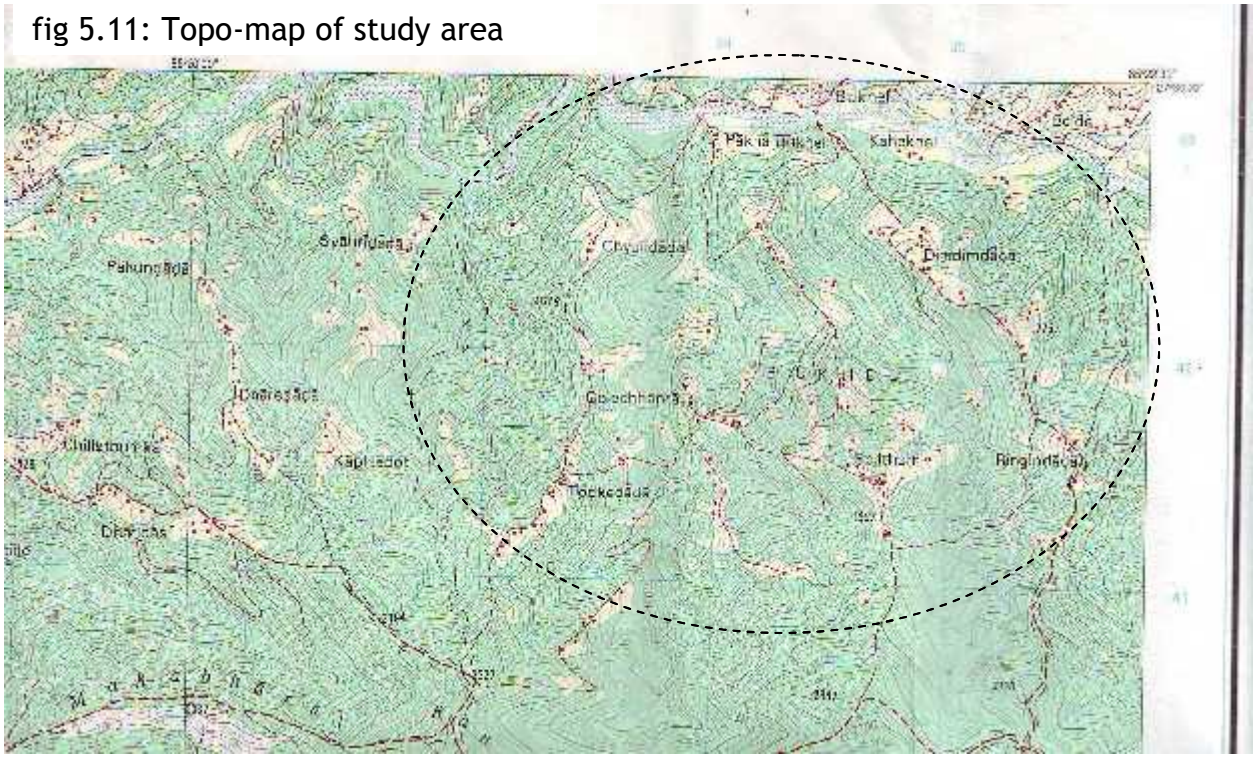
Table 5.10 indicates that the land is being used for traditional as well as commercial food production.

The forestry legend (HDMB2I) gives information that H represents Hardwood (75% or more tree species are hardwood).DMB represents Deciduous mixed leaved.2 represents Crown density (10-40%).I represents Immature or small timber size material.

It indicates that the surrounding region of the study site is covered with forest resources which can be further promoted as herb production, fodder production, timber production, and bio-diversity conservation center.

5.11 Analysis of topo map

fig 5.11: Topo-map of study area



Map 5.11 is the topo-map, sheet no.2785 10 A (Nepal 1:250000) .It shows the study area comes under 633000E to 635000E and 3041000N to 3043000N (UTM coordinates).More than 75% of the study area is covered with mixed forest and 25% with cultivated land and human settlement. The settlement is scattered .The study area varies in altitude from 1300m asl (Bukhel River) to 2000m asl (Todke dada).There is one primary school in Gholechappra settlement(1500m asl). There is one suspension bridge over Tungun River to link Bukhel bazaar with Bukhel road. The study area is in between two small rivers namely Palejeu Khola in the west side and Khamandol Khola in the east which both mix in the Tungun kola.

There is one secondary school (Kalidevi Ma.vi) in Bukhel bazaar connected to Bukhel road by another suspension bridge. There is one health post and one VDC office in bazaar. People have been running various mini hydro plants and improved water mill for local energy fulfillment and grain crushing and hulling purpose. The Bukhel bazaar is connected by a motorable road from Manikhel VDC at two locations .Bukhel bazaar is not connected by a motorable bridge. So during rainy season, farmers have to suffer a lot due to cut off transportation system.
Source: Field survey, 2011

5.12 Analyzing the economic feasibility for the installation of gravity goods ropeway

From literature review, the villages to be connected by the gravity ropeway should be the pocket areas of some produces where commercial farming has already started. If not, there should be enough production in the village to send to the market(the volume of the local produces going to the market should be at least there times more than the volume of consumers goods coming to the village)

The traffic volume (the produces/goods going to and fro the market) should be sufficient enough to ensure the regular (year round) operation of the gravity ropeway and sustain in long run. Presence of well mature community based organization is imperative for its installation, operation and maintenance.

From our field study and analyzing various maps,

- The study site Gholechappra and its hinterland settlements is pocket area for commercial vegetable farming like pea, coffee which has been already started. Moreover, it is also milk production center of the region.
- Land capability map reveals that under the existing agricultural system a large portion of class three is required for fodder production and grazing in order to maintain the productivity of the cultivated lands.
- Land system map reveals that the study site is in middle mountain region which can be developed as animal husbandry potential pocket.
- Land utilization map recommends the production during

  Monsoon season- maize, mustard

  Winter dry season-mustard, potato
- Topo map reveals that more than 75% of the study area is covered with mixed forest and 25% with cultivated land and human settlement. Thus the area also can be developed as forest resource management center inline with agriculture farming.
- There is also presence of well matured community based organizations like Public youth clubs, Tea and coffee co-operatives which can be further developed as co-operatives for the installation, operation and maintenance. Bukhel multipurpose co-operatives for vegetable, milk purchase and selling is an active organization in the region.

5.13 ANALYSING THE ECONOMIC IMPACT OF GRAVITY GOOD ROPEWAY

From the detail calculation in the annex 4,

Money saved during goods transportation in terms of reduced price =2,70,000.00

Money saved during goods transportation in terms of reduced time =11,49,750.00

Thus total money saved both in terms of time and cash=270000+1149750 =**Nrs.14,19,750.00**

As the total maximum investment for the construction is Rs. 15, 00,000 (Singh, 2010) .From the year of operation, the project will be earning profit.

5.14 Analysis about the social and cultural issues about gravity goods ropeway.

Table5.16: Respondents involved in social issues regarding the project

Settlement	Respondent HHs(51)	Total respondents(n)	
		Respondents seeing every thing good about the project.	Respondents seeing something to be addressed if the project is launched.
Gholechappra	7	5	2
Chyulidada	8	4	4
Todke dada	5	5	3
Dimin dada	15	4	9
Lamidada	13	13	1
Solithum	14	10	2
Total	62	41	21

Table 5.16 illustrates that 66.12 percentage of respondents replied that the project has everything good affects in their livelihood. Majority of them replied that their transportation time and physical burden carrying goods and agriculture products is reduced. They said that people who come to bazaar to sell their agric and dairy products spend their time unnecessarily gossiping drinking tea, cigarettes, alcohol, playing cards. They spend 25% of their income in these activities. So if this project is launched, all these social evils will be stopped.

Similarly33.88 percentage of respondents replied that if the ropeway is installed then their will be disturbance in school education (extra coaching class).The technology is not gender friendly as women cannot operate it. There will be less mobility of people as a result social mobility and miscibility, feeling of ownness is reduced. The inter settlement marital relationship will reduced. Farmers become lazy. Information access is reduced. Government will give less priority in road

building. Only rich people (elites) who owns more land and who has more livestock is benefited. The job of porters also ended. What will the project bring the significant changes in the livelihood of ultra poor? The farmers have the habit of daily going to Bukhel bazaar at least a time a day. It has become a part of social culture since generations and a medium of socialization of a child. But the ropeway will cut off all these.

This issue is not measurable. But it can be compared as if a Govar gas stove is introduced in a rural village, most of the HHs will not eat the food cooked in that stove as they say that the smell of the food cooked in firewood is better than it is cooked in stove. Sitting aside by fire, gossiping about the daily family matters in the evening time is the part of their culture. They neither cares that the cooking food in firewood deteriorates their environment, health and consume time. They can't leave this culture as it has been passed to them from ancestors. They believe that without following the transferred cultured from the ancestors, they will be living a meaningless life.

So the installed ropeway technology may not be easily accepted by few HHs due to such socio-cultural issues. These issues also can not be easily addressed as it does not have concrete solution. The time will automatically shift paradigm itself.

Interestingly the whole respondents didn't reply that the project is hindrance to their religious cultural practices.

CHAPTER VI
CONCLUSION AND RECOMMENDATION

6.1 Conclusion

For the all around development of the country a careful development in the transportation sector is necessary. Agriculture sector which contributes 32% in the nation al G.D.P of the country has always been criticized for deficient food production and slow growth rate. But the issues related with the transportation of the produced agric products from agriculture potential rural pockets to the nearby market or road system is under shadow. The harsh topography hinders the mobility of people and goods disconnecting plains with the hills. Head and backloads puts enormous physical burden on health of men and women.

Thus Gravity good ropeway is an appropriate green energy technology for rural goods transportation that needs to be installed in every rural village with no road connectivity and correct topography to improve the rural livelihood. But there is need of more research and development in this sector to make this technology more appropriate to our rural settings.
But still the knowledge based on technical and other socio economic aspects of gravity good ropeway is not that broad. With this limited knowledge base, it is difficult chart out exclusive strategies for its development. Hence more is needed to be done in the areas of research and development.

Based on findings of the study, it is clear that despite an early beginning the development of Gravity goods ropeway in Nepal has rather been slow. To the date 18 gravity ropeway has been installed in various part of Achham, Kalikot, Gorkha, Tanahun, Dadhing, Surkhet and Mustang district of Nepal .But we can work a lot in this sector for the potential development of Gravity goods ropeway to improve rural livelihood. The technical feasibility and socio-economic feasibility that determines about weather the ropeway can be constructed or not and the sustainability of the project is very much necessary .Involvement of academia like engineering institution would be important role in preparing of technical need of the rural community. They can play important role in the preparation of technical guidelines and code of practices. Likely, social research is required to find the niche of gravity goods ropeway in overall transportation sector, explore its potential as the complementary means of transport, identify existing policy hurdle if any propose more conducive policies and strategies.

The Gholechappra settlement is also appropriate place for the ropeway construction. As it has no road connectivity and it is very potential rural pocket for agriculture productions. The length (491 m) and the slope angle (25.6°) of the proposed ropeway also matches the standard terms and

conditions of Gravity goods ropeway construction. Social issues dug out during this research work also must be addressed.

Mainly the issues like elite dominations, female's physical inability to operate the ropeway, disturbance in school education as the bottom station is proposed in school premises and mainly the reduction of mobility of people from village to the market which in turn affect the marital relationship, feeling of own ness among the people of different settlement, social miscibility must not be neglected.

6.2 Recommendation

6.2.1 Recommendation for policy measures

The following recommendations have been made based on the findings of the study.

- Gholechappra has to be developed as small market center with "Integrated service center" providing services like veterinary, agriculture seeds, information and communications etc.
- The school of Gholechappra has to be upgraded up to secondary level. This can serve the students of surrounding settlement. It is better to establish child clubs at every settlement and school of the region for the institutional development at grass root level.
- The graveled road that connects from the Bukhel bazaar to Gotikhel must be pitched and a motor able bridge has to be constructed on Tungun Khola between Gotikhel bazaar and Bukhel bazaar.
- More employment should be created to those locals who own less land. Different skill promotion trainings should be provided before launching of the project so that local people may get skilled jobs which are important for the sustainability of the project. Special program for disadvantages, children should be provided. To reduce illiteracy and poverty adult, children and women education is utmost necessary.
- A concept of multiple Gravity goods ropeway (two ropeways), that links Todke Dada to Gholechappra and Gholechappra to Bukhel bazaar can be further promoted. Later Todke Dada can be developed as Small market center.
- Developing monitoring capabilities of the affected peoples and of local non governmental and civil society organizations should be encouraged and ensure participatory monitoring.
- The social hidden issues regarding the construction of Gravity goods ropeway like reduction in people's mobility, elite's domination, male domination must be addressed. The operating and management system of this whole transferred technology must be done by the local groups. For this the previously existing group can be revitalized or it can be converted as "Vegetable and dairy co-operative". But the group must be properly trained like meeting conduction, participatory development, leadership skill etc. Further more a

monthly *mela* must be organized at Bukhel bazaar for providing platform of gathering to the people of different hinterland.

6.2.2 Recommendation for further research

- There is need to know more about the benefits of existing Gravity goods ropeway projects in Nepal. What kinds of benefits are provided by the Gravity Goods Ropeway? Who have been benefited from these projects so far? What are the different kinds of benefit sharing mechanisms adopted by Gravity goods ropeway and which ones are more likely to contribute to social equity and environment justice?
- Often, Gravity goods ropeway pay attention only to financial costs. Additional research is needed on the social, economic and environmental costs of the projects. Who, if any body suffered from the development of Gravity goods ropeway project in Nepal? Were any social groups and regions subjected to disproportionate risk? Was the distribution of the service fair?
- Can this model of transportation be developed as human transportation in emergencies?
- Can the energy being dissipated in GR be harvested -For operating pneumatic tools for operating simple machines?
  -sawing of woods etc
- Can the alignment of sheave be changed?
  -horizontal to make a single cable operation to decrease costs
- Can the Hybrid type ropeway be constructed?
  - possible way of combing power with hydro and gravity ropeway
- How could this technology be wider disseminated?
  -DDCs, private sector, programmes of GO/NGOs
- How could this installation system be affordable?
  - facilitate linkage with credit institutions and Government Subsidies
- What could be done in Research and Development of this technology?
  -collaborate with academia in research for advancement of technology
- How could we integrate this technology with other livelihoods and transport related programmes?
  -complimenting roads, bridges, markets etc.

References

CBS (2008). *Nepal in figures*, Central Bureau of Statistics. Kathmandu.

DoLIDAR and Practical Action Nepal Office (2010), *Technical Guidelines for Gravity Goods Ropeway*, Practical Action Nepal Office, Kathmandu.

Hada, J. (2009).*Gravity Ropeways for hill communities in Nepal. Proceedings of International conference on Renewable Energy Technology for Sustainable Development*.12-14 November 2009, Kathmandu.

Intensive study and research center, (2010). *District and VDC profile of Nepal,* Kathmandu.

Kantipur daily (13 July 2009). *Nepal economic survey, data of first eight months, 2008/9.*

KC, L. (2010).*www.google.com/Practical action Nepal,* Kathmandu.

Mandal, U. (2010).*Theoretical hands out given to students of Rural Development Department of university Campus*, TU, Kathmandu.

Nepal, R.M.(2010).*Technology of Rural Development*, Kathmandu.

Pradhan, P. (2004).*Rural urban relations*, Rural Urban Partnership Programme, Kathmandu.

Pradhan and Pradhan (2006).Environment *and Natural Resources: concepts, methods, planning and management*, Quest Publication, Kathmandu.

Luitel, A .(2063).*Gravity ropeway Jankari Pustika* , Practical Action Nepal Office ,Kathmandu.

Rural Energy Policy (2006). Government of Nepal, Kathmandu.

Sharma,P.(2007).*A handbook of Social Science Research Methodology*, Kirti Publication, Kathmandu.

Shrestha, M.(2009).*Socio-Economic Impacts of Solar Water Pumping System in Rural Nepal. Proceedings of International conference on Renewable Energy Technology for Sustainable Development*. 12-14 November 2009, Kathmandu.

Shrestha and Parajuli (2010). *Rural Technology and Skill Development*, Kshitiz Prakashan, Kathmandu.

Singh, R. (2010*). Gravity goods ropeways development in Nepal. Paper presented in Central Department of Rural Development*, 14 September 2010; TU, Kathmandu.

Post report (2009 July 13).The Kathmandu Post.

Himalayan News Service (2010 May 20).The Himalayan Times.

Singh, J.(1994).*Agriculture geography, second edition*, India.

www.ddclalitpur.gov.np

www.googleearth.com

www.google.com/Practical action, Nepal